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Stokman, Frans N.; Doreian, Patrick

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CONCLUDING REMARKS

FRANS N. STOKMAN

University of Groningen

PATRICK DOREIAN

University of Pittsburgh

Dynamics and evolution of networks are not studied widely by social network analysts. In most fields, collecting longitudinal social networks data requires large resources and is very time consuming. We note that the data collection problem for social networks is *more* acute given the inclusion of relational data in addition to attribute data. Further, analyses of social network data require their own methods due to the mutual dependencies between actors and between ties in social networks. Most standard statistical methods cannot be applied in social network studies. As a consequence, social network researchers have relied on specific social network methods and measures. In general, these have been descriptive. Yet, because of the statistical complexities involved, most of these methods are limited. Even comparisons between networks of different sizes and densities are very problematic. Within this setting it is not surprising that most efforts are focused on analyses of *static* network structures. (See Doreian (1980).)

The compendium of Wasserman and Faust (1994) and the much improved and extended standard computer package UCINET indicate that the social network field is now mature enough to go deep and to turn to more difficult questions of dynamics and evolution. This state of the art justifies the emphasis of the present volume on indicating some paths to follow within a broad methodological orientation. Even so, it will be necessary to focus also on substantive dynamic and evolutionary results in different fields of application. While we have defined our focus in terms of techniques, tools and approaches, we believe that, for specific topics, substance is critical. Consequently, all of the contributions give important substantive insights into the development of network structures in different empirical settings.

Dynamics is a broader concept than evolution. Whereas ‘dynamics’ refers to change and can be purely descriptive, ‘evolution’ includes explanations of dynamics. Evolution refers to underlying processes that generate the dynamics in social networks. The contributions illustrate different types of processes by which social network evolution occurs.

In many social network evolution studies, the underlying process for network change is assumed to be located in the network structure. An example of this approach is found in the contribution of Doreian et al. Empirical studies of friendship choices repeatedly report levels of reciprocity well above chance levels. This raises the idea of studying networks over time to see if we can explain network changes towards reciprocity of friendship choices. Doreian et al. apply these ideas to the Newcomb fraternity data (Newcomb, 1961). They show that reciprocity is well above chance level from the very beginning, but does not increase over time. In sharp contrast, transitivity of choices initially is not above chance levels but increases substantively over the first eight weeks, remaining constant at that high level afterwards. The degree of 'structural' balance also increases over time. One important insight from this study is that different network phenomena can operate with different time scales in the same social collectivity. In addition, the study provides a new methodology to assign values to rankings that maximize certain network characteristics (e.g. reciprocity of relations).

In the Skvoretz et al. contribution, the emergence of dominance structures is explained by two mechanisms. If a network member attacks another network member, a dominance relation from the attacker to the victim is created with a certain likelihood. This is the 'victim effect'. Other dominance relations result from the 'bystander effect'. Skvoretz, Faust and Fararo assume a cognitive process in which bystanders tend to dominate the victim and to form a deference orientation to the attacker (and the attacker a dominance orientation to the bystander). They demonstrate that the bystander effect is a necessary condition for hierarchical structures to be formed.

In other social network evolution studies, the underlying process for network change is assumed to be located in the characteristics of the network members. They are assumed to choose others by comparing relevant individual characteristics of the others with their own. A fundamental finding in many choice networks is that social actors with similar characteristics are more often connected with one another than they are with actors having dissimilar characteristics. This is known as the similarity effect in social networks (Schachter, 1959). Many researchers attribute this to a selection process in which social actors tend to choose similar others. The Leenders contribution on some dynamics of friendship and best friendship choices is an example of this approach.

A number of network evolution studies take the goal structure of the network members and the instrumental character of the network as their starting point to model evolution. Network members try to create relations and network positions that produce desired outcomes. The emergence of networks thus becomes linked with effects on desired outcomes. This implies the linkage of network analysis with rational choice models and social production functions within the perspective of the micro-macro link (Lindenberg, 1985; 1990; 1995). The present volume contains three examples of this approach to social network evolution. All three rely heavily on computer simulation to investigate the implications of theoretical assumptions on the evolving network structure and the effects on other outcomes.

Zeggelink, Stokman, and Van de Bunt focus on the emergence of groups in the evolution of friendship networks. Since Zeggelink et al. consider friendship as an intrinsic goal of network members, they do not view friendship relations as instrumental for the attainment of other individual goals in their models. As a consequence, their main results concern systematic variations in network structures under different assumptions and the effects of these structures on the success of network members in obtaining their desired number of friends. In sharp contrast, the contributions of Flache and Macy and of Stokman and Zeggelink focus on the instrumental value of informal networks for external goals: compliance with group obligations (Flache/Macy) and policy outcomes (Stokman/Zeggelink).

In all three individual goal oriented contributions, networks evolve because actors simultaneously attempt to optimize their own network relations. Even if actors have full information on the present state, as both Zeggelink et al. and Flache and Macy assume, the effects of their choices may strongly deviate from their intentions. Due to the simultaneous choices of others, the present changes before their own actions come into effect. In other words, the present is the wrong situation to be optimized and the choices of others should be anticipated. Of course, such optimization problems are magnified by incomplete information. Forward-looking analytic solutions may be impossible in these situations, for actors as well as for modelers. The principles of learning from past experience (Macy, 1990; 1991) and of imitation of successful others (Heckathorn, 1995) become increasingly important and can be applied successfully to social network evolution. Both the Stokman and Zeggelink and the Flache and Macy contributions demonstrate this.

Advances in studying network evolution come through simulation modeling and process oriented network models. Yet the promise of both approaches is limited without really confronting the results of the dynamic simulation models with empirical data. To do this, it is clear that both longitudinal data sets and adequate statistical tools for the analysis of these data are indispensible. The contributions of Snijders and of Banks and Carley are important as they are critical steps towards developing adequate statistical tools for the analysis of longitudinal network data. The simulation studies also suggest the nature and timing of the necessary data collection efforts.

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